Thinking outside the sphere

Carlisle Public Safety Radio: Dispatch Console and Leased Lines Report

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Contents

Table of Figures

Report Summary

This report is presented in partial fulfillment of the Public Safety Communications System Documentation, Assessment, Analysis, and Recommendations for Upgrade Project conducted by Isotrope for the Town of Carlisle. The Carlisle RFQ Scope of Services section d.i. sought:

> *d. Considerations and Recommendations*
>
> *i. Evaluation of current dispatch console and recommendations for replacement of console if needed in proposed system.*

The first section of this report describes an evaluation of the dispatch console and provides recommendations responsive to this task. In addition, the Police Department relies on leased copper lines from the local telephone company, Verizon. The issue of the reliability and the continuing availability of the lease lines or any viable substitute arose as another factor in the reliability of the Police radio network. The Police radio network relies on "voting receivers" strategically placed around town where portable radios have difficulty reaching base. These voting receivers rely on dedicated leased telephone lines to link with the "comparator" at the dispatch point.

The second section of this report discusses the leased line issues and provides recommendations.

Carlisle Communications Console

System Overview

The Town of Carlisle operates a single town 9-1-1 Center [called a Public Safety Answering Point or PSAP]. This PSAP function, which is responsible for 911 call answering and handling, as well as dispatching First Responder personnel. The dispatch center is located in the dispatch room within the Police Station.

Figure 1: Dispatch Console

Figure 1 depicts one of two Carlisle Public Safety Dispatch positions.

Key to the operation of the dispatch center is the ability to communicate by radio to police, fire, and EMS personnel, and to other agencies, including public safety agencies for mutual aid in surrounding towns. This is done through a computer display and application that is interfaced to many different radio channels. A dispatcher simply selects a box on the screen indicating a certain channel [e.g., Police, or Fire-1] and then presses a button or footswitch while speaking into a microphone or headset to transmit a message to one, several or all units listening on that radio channel.

Depending on how a dispatch center configures its console, dispatch consoles can also enable dispatchers to open doors, initiate fire alert paging, talk to surrounding fire and police agencies, and patch radio channels together so users on different channels can communicate.

The current Carlisle dispatch console is a Motorola Centracom Gold Elite console that was installed in 2007. The console is typical of a local 9-1-1 dispatching facility, where the dispatch console is a desk-top arrangement of electronics, as shown in Figure 1.

The console position comprises a Dell personal computer, flat-panel computer screens, and CIE [Console Interface Electronics package] where the physical interfaces to the system reside:

"select and unselect" speakers, volume controls, microphone and local and external PTT (push-to-talk) connections, and VU (audio level) meter.

The dispatch console position is interfaced to the electronic rack/cabinet located in an upstairs separate and secure room. These racks are called CEBs [Central Electronics Bank], where remote base station equipment, voting receivers, and console position CIEs are connected for console operation. All base station, repeater, and voting receiver equipment located on site and at remote locations are connected to the CEB.

Connectivity between the Police Department console and the main transmitter site at the school is via fiber optic cable and TDM multiplexer. The remaining circuits linking remote voting receivers to the dispatch system are 4-wire, 600 ohm analog dedicated circuits leased from Verizon. Local copper wiring is used to connect local radio equipment to the CEB. Figure 2 illustrates the arrangement of the systems at the Police station.

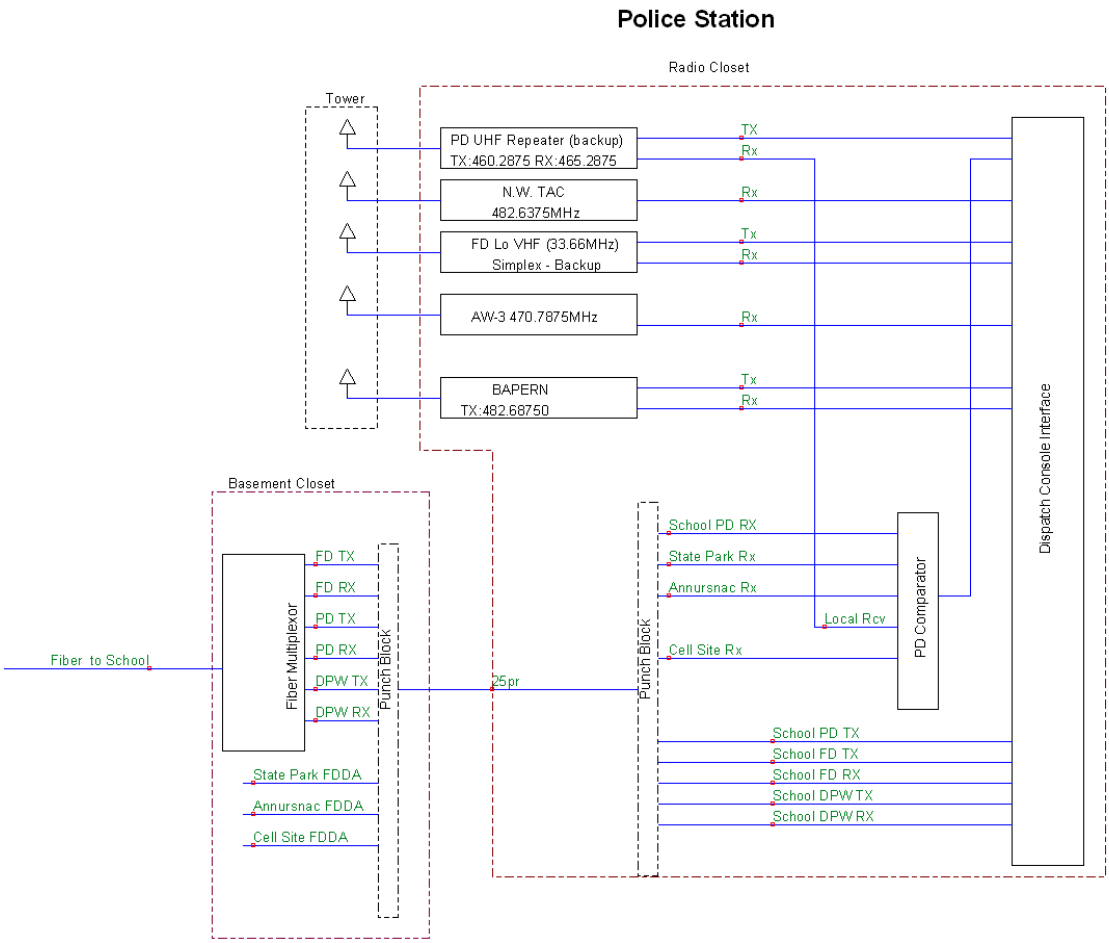

Figure 2: Police Station System Block Diagram

The town also utilizes Computer Aided Dispatch [CAD] and Police Records Management System [RMS] applications that enable dispatchers to enter information about calls and to track the status of incidents and personnel. At a glance, for example, a dispatcher can see whether a police car is available on patrol or – if they are assigned to an incident – where that incident is located and what type of incident it may be.

Information in the CAD is searchable in many ways, both in support of a currently active incident and for later searches and statistical reports. Also the CAD is one official record of police activity and select information from it is made available as the public Police Log. The fire services have a separate fire CAD application that is similar to police but also provides pager tone alerting information, incident management, as well as in-station/out of service apparatus status.

Other console function and features include multi-line telephones, automatic vehicle location [AVL/GPS], emergency button monitoring, radio unit PTT (push-to-talk) identification [police only], alarms, and a variety of computing systems for operational and administrative purposes.

The Carlisle dispatch console utilizes the following radio channels to communicate with First Responders:

Police (UHF) (Repeater)
Fire-1 (Lo-VHF) Simplex
Fire-2 (Lo-VHF) Simplex
Fire UHF (Primary Repeater – simulcasts Fire-1)
DPW (Hi-VHF) (Repeater)
BAPERN (3 UHF channels)

In addition, the dispatch console is configured to activate 18 Alert Paging configurations and 4 Remote Alarm closures.

The picture below shows the Town of Carlisle radio dispatch console screen (Figure 3). The screen represents Town Public Safety and Public Service radio capabilities. Please note that radio system configuration and connectivity is discussed elsewhere in this report. The screen represents the radio system “dash board” where the dispatcher can communicate with any first responder’s mobile or handheld portable radio on one of the selected radio systems. The console serves as a human interface that connects to push-to-talk [PTT] dispatch radio systems.

Audio from all radio channels is processed through audio level compression circuits and is routed to two separate speakers identified as “Select” and “Unselect”; each has a volume control. The Select channel carries the highest priority communications. To prevent missed messages on critical channels, the Select volume is configured so it cannot be set to an inaudible

level. Unselect channels may be used for special events, other agencies, or purposes that do not involve dispatch and may be turned inaudible when necessary. By pressing a button, any channel on the console can be toggled between Select and Unselect status. Each channel has an independent PTT button, allowing the dispatcher to talk over one channel at a time. For broadcast messages, each channel can be part of a multi-select configuration allowing the dispatched to single transmit over all selected channels at the same time. A digital clock and an LED bar graph or VU (volume) meter are included.

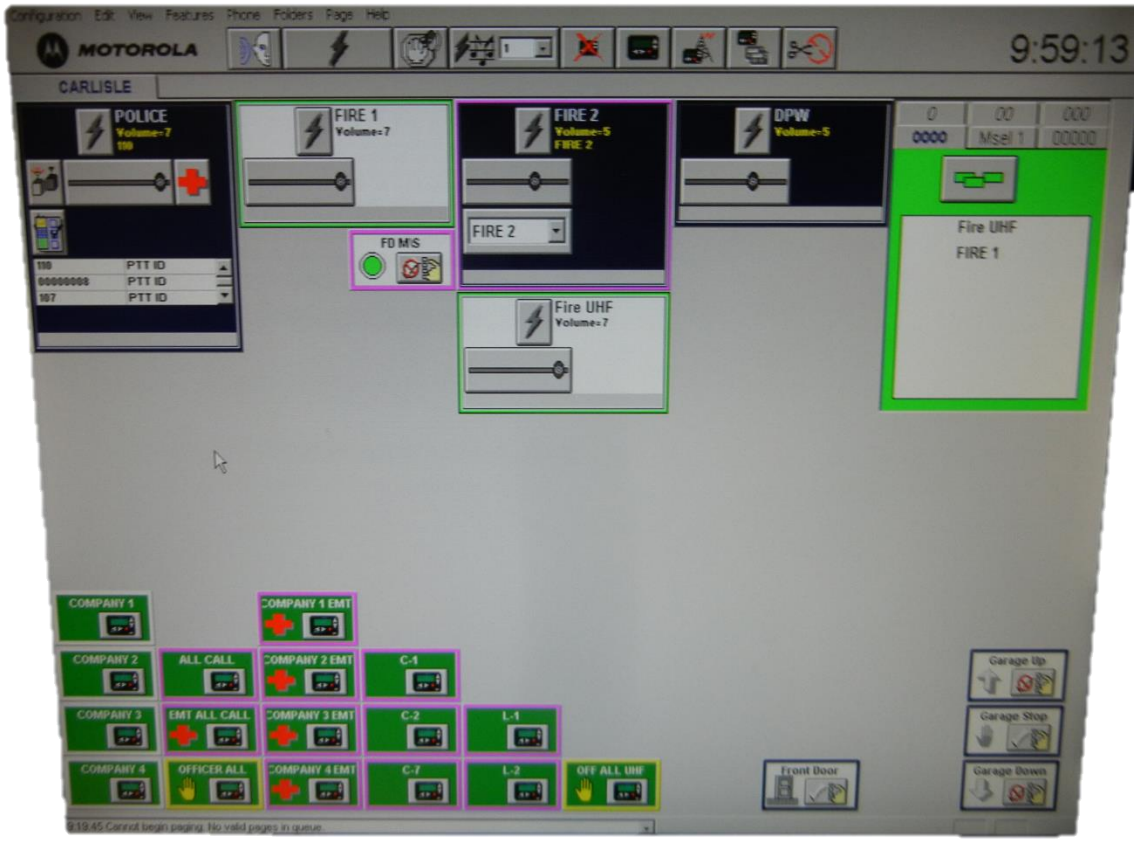

Figure 3: Dispatch Console Screen Shot

Each channel has a label/identifier, status indicator lights and buttons to control settings. A typical channel has a busy light, a call light, select light, select button, and a transmit button. The steady, red busy light indicates another dispatch position is transmitting on the channel. The flashing yellow call light indicates a field unit is talking on the channel. The call light usually blinks for several seconds after a transmission ends allowing a busy dispatcher to look up from a telephone call and determine which channel the last message came from.

End of Life Issues

Similar to IT and computer hardware/software systems, radio systems have planned periods during which systems and components are manufactured, sold, supported and finally abandoned. This results in the planned discontinuation ("cancellation") of manufacture and support ("end of-support") for radio system equipment. At the time of manufacturer-imposed end-of-support, vendors no longer guarantee that components will be available for repairs.

The current Motorola Centracom Gold Elite communications console system has reached its cancellation date for product availability and software support. Cancellation occurred in 2012, when expiration of Technical Support and System Support Center [SSC] marked the official end of Motorola's factory support for this equipment. A while later, warrantee support of the newest models was allowed to expire. Motorola states the console will be supported for parts-on-hand until about 2018. The Motorola replacement for the Centracom console is the MCC7500 console.

Once the EOL date is reached, system-level support is no longer available. Motorola shifts its support from system-level to component-level repair service. System-level service provides Motorola factory technical support, software upgrades and parts. Component-level service only offers a limited supply of replacement parts to support replacement of boards and other components. Component level support is dependent on the availability of spare parts, many of which are no longer being manufactured. Component-level support also requires a local vendor with enough experience with the product to be competent at performing board and part replacement without factory guidance.

Motorola will typically support its product at the replacement parts level for 5-7-years after the expiration date for manufacturing [EOL]. Motorola stockpiles a large inventory of spare parts to meet its customer base requirement, typically over a 5- 7-year period. However, Motorola's support during this timeframe again is "best effort"; with no guarantee that component parts will be available. Motorola and other manufacturers periodically publish product cancellation and end-of-support memos to update changes and additions to the product list. There is a secondary market for popular products in which third parties collect used equipment and buy up stocks of spare parts to support a product during and after its factory EOL cycle. It is expected that there will continue to be parts available even after 2017-2019, but when it is the sole means of dispatching for public safety, it is prudent to replace a system before it becomes risky to keep it in operation.

Current State – Communications Dispatch Consoles

Communication consoles are used for basic radio dispatch functions, primarily command and control of base station and repeater equipment, voting receivers, alert paging, and control and management of various audio sources and destinations. Consoles are used in conjunction with

other support systems, including such things as logging, reporting of caller information, incident management and reporting and similar functions. Much of what consoles and related systems do are driven by standards adopted by entities such as TIA (Telecommunications Industry Association) and National Fire Protection Association (NFPA), where applicable. Other functions such as door/equipment control, radio user ID's, etc. can be integrated in the console.

The table below shows common console functionality available from all major console vendors. This is the feature set that is required by the public safety communications community in the vast majority of installations, so it is provided as standard functionality in console designs. Not all functions are required for a given dispatch PSAP/dispatch facility. Customary console functions are listed in Table 1 below [yellow highlight indicates features not used by Carlisle PSAP]:

	FUNCTION	PURPOSE
CHANNEL FUNCTIONS	Channel or Talkgroup Select	Selects the desired transmitter to operate
	Crosspatch	Crosspatches multiple channels for multi-casting
	Busy Visual Indicator	Indicates that channel is occupied by other dispatch position
	Manual Transmit	Individual PTT switch on channel module
	Individual Volume Control	Individual volume control on channel module
	Call Visual Indicator	Indicates receiving calls
	Channel Cross mute	Mutes channel modules to prevent feedback interference
FUNCTION & CONTROL	Master Transmit Switch	Transmit manually on all selected channels
	Master CTCSS Monitor	Temporarily disable the receiver CTCSS decoder
	Master CTCSS Disable	Temporarily disable the receiver CTCSS decoder
	Select Speaker	Monitors selected channels
	Unselect Speaker	Monitors un-selected channels
	Monitor Speaker	Monitors specific channels
	Microphone	Desktop gooseneck microphone
	Clock	24 hour LED
	VU Display	Indicate transmit audio levels
	Footswitch	Dual pedal footswitch for PTT and CTCSS (tone squelch) disable
	Intercom	Provides intercom between positions and base stations
	Simultaneous Select	Manually select any combination of channels for simultaneous broadcasts
	All Points Bulletin	Console controlled channels for simultaneous broadcasts
	All Receiver Mute	Mutes received audio from all unselected channels
	Alert Paging Tones	Provides singaling tones for alert paging
	Alert Tones	Over the air steady or warbling tone for alerting
	Crosspatch	Provides cross-connection of audio between channels
	Auxiliary Signal Input	Signal input to support external encoders and/or signaling devices
	Independent Auxiliary Control	Eight auxiliary control switches with indicators at each operator position to control relays
	External Input Indicator	Eight external inputs indicators at each operator position

Table 1 - Standard Console Features (with Carlisle's unused features highlighted yellow)

Our site visit to review console equipment and discussions with the center's manager did not identify functions or features that were not being met, or new functions or features that may be required for the future. All dispatch consoles available for typical Town dispatch centers, such as Carlisle, have the required feature set to perform the dispatch function required for Carlisle's

day-to-day and emergency dispatch operation. [However, large dispatch centers may require other functions and features that are not normally needed in smaller centers, such as console intercom, supervisory/training functions, or specialized muting functions; Carlisle requires none of these additional features].

Radio control and dispatch operations have not changed much over the past three quarters of a century. The technology making it possible has become more reliable, configurable and user-friendly, but the basic functions remain the same. Just as computers and other electronic communications have migrated to central server base equipment and IP (Internet Protocol) connectivity, so have dispatch consoles. Communications console vendors are now providing IP consoles, as this IP networked technology is more flexible than consoles designed for legacy switched networks [600 ohm lines, T1s, etc.]. Central server-based consoles make it easier to install console positions [anywhere] and substantially reduce the space required for the "back room" rack equipment. Purpose-built appliances are replaced by off-the-shelf computer technology of servers, switches/routers, and gateways.

Figure 4 is a conceptual design for an IP-based console system.

Adopting the IP technology inherently upgrades system reliability and audio quality, and improves the ability to implement cost effective redundancy and back-up solutions. As the radio systems may still employ older equipment, interface devices called "gateways" are required to connect the radio technology to the IP network.

Today, this transition to digital connectivity has already begun in Carlisle. At the Police dispatch point the console itself is a digital user interface that connects to the hybrid digital-and-analog CEB. Analog links are maintained to local equipment and the remote voting receivers, but one digital link has been installed. The link to the radios at the school site is a digital link carried on town fiber optic cabling. The analog signals at the CEB end are converted to digital format for the fiber link to carry. At the school site, there are converters that translate the digital link back to the analog signals that the radios at the school site require. This fiber optic link is not presently IP based, but with a quick changeout of equipment, the fiber backbone could support an IP based network.

If an IP-based console were installed, the present analog-to-digital conversion to fiber at the Police station would be eliminated, and only a set of gateways would be needed at the school site. Only the repeater end would continue to have a gateway. As the radio technology is upgraded, direct IP connections to new radios would eliminate the gateways.

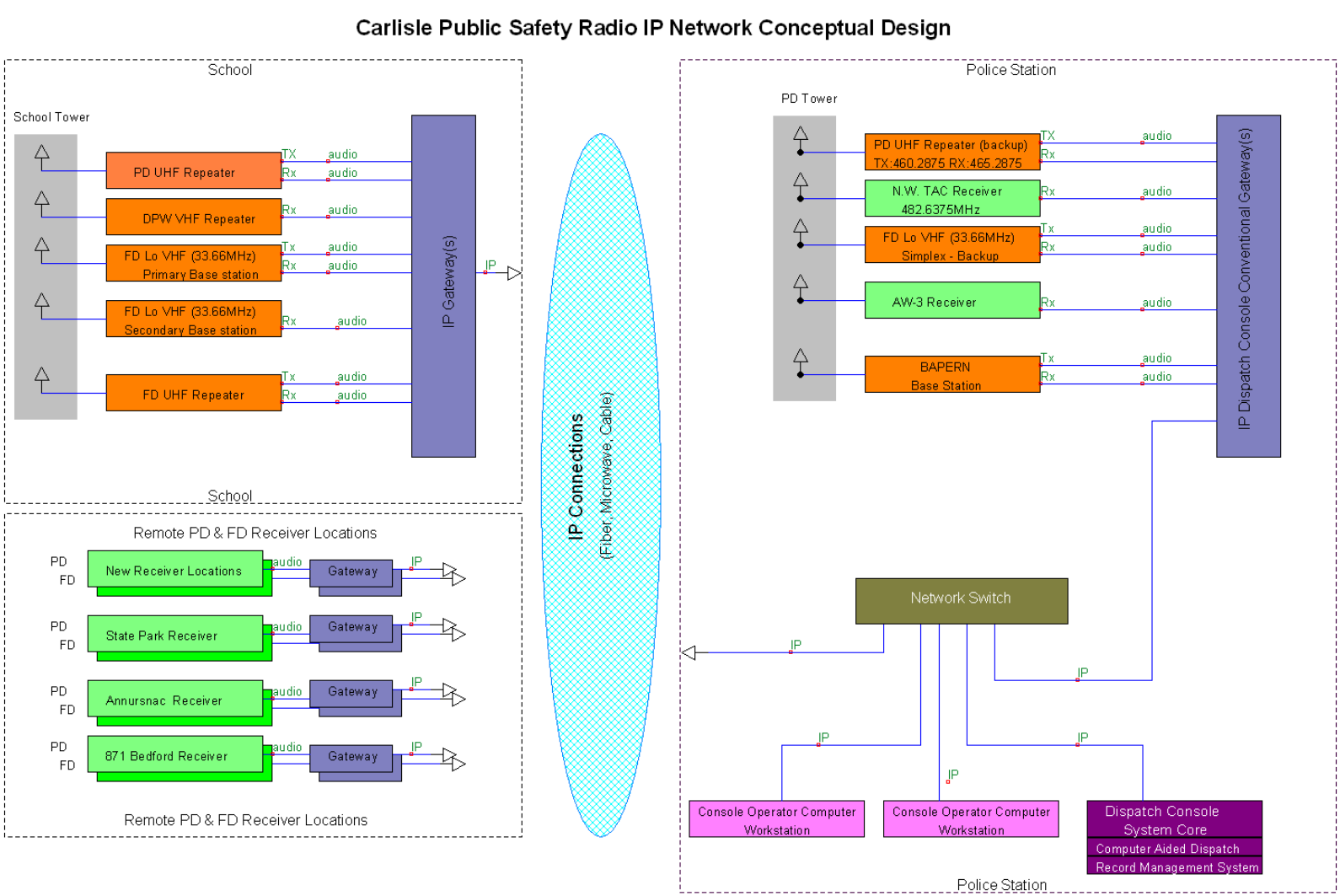

Figure 4 – Carlisle IP Console System Conceptual Design

As the foregoing description implies, the console itself is fairly straightforward technology. It is the specific combination of interfaces to the radio network that defines the needs of one town's console configuration versus another's.

There are several manufacturers providing console equipment. Some products cost more than others for a given list of basic specifications. This is due to several variables among manufacturers: brand recognition, manufacturing quality, sophistication of supporting software, depth of product support; however, all can provide the required minimum dispatcher functionality. Console offerings today are proprietary hardware core-based or central server core-based systems. The former utilizes the CEB electronics frame that was introduced above. Carlisle's CEB is depicted in Figure 5 below.

Figure 5 - Carlisle Dispatch Central Electronics Bank ("CEB")

In addition to the product quality, there are two critical items that need to be reviewed in any console procurement process, they are: [1] level of manufacturer initial and ongoing technical support; and [2], the technical expertise of the local technical service provider – these two items are essential to ensure continued console performance and reliability during the console's lifecycle.

Console design is steadily migrating toward IP (internet protocol) based solutions. This lowers cost and increases reliability because ordinary off-the-shelf networking product can be utilized instead of manufacturer-proprietary interfaces. In addition, the system core can be addressed from a console computer wherever the console may be located or relocated because the municipal local area network will support a connection between two devices who know each

other's IP addresses. This makes it simpler to add consoles in the future or relocate them (as backups or permanently with facility relocation). Other than the generic computer and a few application-specific interfaces (mic, speakers) no specialized hardware is necessary to configure a new console.

Switch-Based Consoles

Consoles are still available in traditional switch-based models for small dispatch operations, such as the console depicted in Figure 6.[1] They are relatively inexpensive, but lack the more advanced features integrating CAD, RMS and other services that enhance the effectiveness of dispatch communications. This is likely why Carlisle is not presently using a simple switch-based console.

Figure 6 - Zetron Switch-based Console

Hardware Core-Based Consoles

Carlisle's current console is more sophisticated than the switch-based type, providing a more flexible user interface (computer screens plus a limited selection of physical knobs and buttons) and integration with CAD and other applications. Figure 5 above is typical of hardware core-based console technology. There are often at least two layers of signal translation between the radio equipment and the console. The first occurs at the radio equipment site where the signal coming off or going into the radio is of a particular electrical format and must be converted to something that will carry over an analog or digital dedicated telephone line or other kind of link (e.g. fiber or microwave). Then when the signal arrives at the dispatch center, it has to be translated from the format that carried it over the link to the format that the console and core can handle. This is the role of the CEB, with its many kinds of plug-in cards enabling all manner of telecommunications formats to be translated to console readable form.

In Table 2, the left-hand column illustrates the signal translation scheme for hardware-based core technology. This shows why the CEB is a large rack frame with dozens of plugin-cards. Each card and each connection from a phone line to a card is a potential point of failure.

[1] The mention of any specific product in this report is meant as an example and is not intended as an endorsement of any particular brand or model.

In the IP world, the right-hand column of Table 2 shows how the signaling at the radio site would be promptly converted to IP by a gateway. In newer models of radios, the IP conversion will be available internally to the radio, thereby eliminating the freestanding gateway. One model of gateway is shown in Figure 7.

Hardware-Based Core	Server-Based Core
Remote radios and devices	Remote radios and devices
Translations to telecommunications link formats	IP Gateways
Telecommunications links	IP over telecom links
CEB: Hardware interface for each telecom line coming in. CEB translates from telecom formats to console format and performs other management and control functions.	Core server performs all management functions in software. Hardware interface is an Ethernet connection.
Proprietary link to console	IP over LAN
Console	Console

Table 2 - Structural Comparison: Hardware- and Server-Based Core Console Systems

Figure 7 - Zetron Model 6300 Gateway

By utilizing an IP-based Console system, the bulky, proprietary, and vulnerable CEB cabinet is replaced by an ordinary computer server running the console vendor's software. The parts count for the system is significantly reduced. The server can be backed up for the cost of a duplicate server. Software upgrades can be maintained for the cost of annual subscription or one-time fees. System expandability is only limited by the processing power of the server.

As with many technologies migrating to IP based operation, there is essentially no down-side to selecting an IP-based console in the next generation.

Based on the foregoing evaluation, below is a summary of recommended minimum requirements for a new console system. In the process of finalizing specifications additional requirements may be developed.

Table 3 - Console System Requirements

Criteria	Notes
Channel or Talkgroup Select Crosspatch Busy Visual Indicator Manual Transmit Individual Volume Control Select/Unselect channels Call Visual Indicator Channel Cross mute Master Transmit Switch Master CTCSS Monitor Master CTCSS Disable Select Speaker Unselect Speaker Monitor Speaker Microphone Clock VU Display Footswitch Intercom Simultaneous Select All Points Bulletin All Receiver Mute Alert Paging Tones Alert Tones Crosspatch (at least three independent simultaneous) Auxiliary Signal Input Independent Auxiliary Control External Input Indicator Interface to Police CAD Interface to Fire CAD Police RMS interface AVL support E-911 ANI data capability PTT ID capability Voice logger interface/support	This collection of features is from Table 1. All are employed by Carlisle in the current system. All features are available in standard console systems.
Support automatic call rerouting plan per NFPA 1221-8.5	Rerouting procedure not known.
Support priority, monitoring, logging, integrity and other criteria of NFPA 1221-9, as applicable.	Current systems probably conform.
CAD systems shall conform to NFPA 1221-10, as applicable	Current systems probably conform. Separate from Console system.
No public internet links allowed for alarm and dispatch functions. (With appropriate security, an internet connection may be provided for dispatcher to obtain information from the internet in the performance of dispatch duties)	Current system conforms. New IP based system can rely on current link from PD to School. Dedicated remote links must be upgraded to digital private circuits (replacing analog copper dedicated circuits)
Analog and P25 digital radio compatibility	Current system conforms.
Operating positions: 2 (expandable to at least 4)	Current system has 2. Expandability unknown, and not relevant for current system.
Support for operating positions, primary and backup, in multiple locations	Current system not presently configured with backup location capability.
Minimum 24 communication channel capacity (radio and telephone); extensible to larger array of I/O for	Current system has sufficient capacity for current needs.

future expansion or merging of dispatch functions	
Touchscreen and/or mouse based operation (non-mechanical-switch-based console) to minimize parts failure and parts obsolescence risk	Current system conforms.
Customizable GUI with ergonomic user interaction (low-stress, non-distracting, task-focused, intuitive presentation)	Current system essentially conforms. Newer console designs incorporate latest thinking in dispatch UI.
SNMP support for alarm/status reporting in real time	Current system not IP based.
Reliable hot-standby core capability	Current system does not have this feature.
Dual network I/O for redundant network path access	Not relevant to current system, as it is not an IP system.
Levels of password-protected access depending on user rights	Available in current system
Gateway support for all major technologies: including without limitation 2/4 Wire PTT/COR; Tone Remote Control support; Analog radio; P25 radio; aux control/closures/sensors	Not relevant to current system, as it is not an IP system.
Support low latency LAN infrastructure specified to <40/<20 ms packet delay/jitter	Not relevant to current system, as it is not an IP system.
60 minute backup power supply	UPS presently in place on key components. Batteries might not be full 60-minute capable. Reliant on generator to minimize reliance on batteries. 60 minute time should be designed into future system in case generator fails; 60 minutes provides time to scramble to supply alternate power.

Public safety communication consoles are provided by multiple manufacturers, including:

Motorola Solutions, Inc.
Harris Corporation
Avtec Inc.
Catalyst Communication Technologies Inc.
Zetron, Inc.
Telex Radio Dispatch
EF Johnson Technologies Inc.

Dispatch Console Recommendation

Although Carlisle's Motorola dispatch console has reached its end of life cycle, it can continue to provide reliable service for at least the next 3 to 5 years. Replacement parts and components continue to be available from Motorola until 2018. Furthermore, refurbished or reconditioned CIE [Console Interface Electronics] audio/speaker module, as well as CEB [Central Electronics Bank] circuit boards can be found on the secondary market should the Town desire to obtain and store field replaceable units. Equally important to component availability is the need for experienced technical personnel providing ongoing service and maintenance for this equipment.

Based on the foregoing, the process of funding a replacement for the console should begin right away. One way to move forward is to issue a request for information to obtain MSRPs and recommended configurations, qualifications and experience, and support capabilities from interested parties.

Leased Line Discontinuance

Overview

Public Safety has relied on dedicated 4-wire analog circuits leased from the carriers for connectivity to and from radio sites and dispatch centers for more than 60 years. These leased services have traditionally offered an effective low cost, low bandwidth transport medium for radio communications.

Both Verizon and AT&T have announced preliminary plans to discontinue dedicated copper based services in various markets across the country within the next several years. Some leased services based on 2/4 wire analog technology have already been declared end-of-life and dates to stop supporting them have been announced to some customers.

The decision to end support of copper facilities is the result of cable infrastructure age, and its inherent narrow bandwidth limitations. Furthermore, the Carriers cannot afford to maintain both analog and IP networks to remain competitive with other providers, such as cable and/or wireless companies.

The trend is to migrate to IP-based circuits for both voice and data. IP infrastructure can be easily scalable to allow increased bandwidth on demand. Leased services using fiber, microwave radio, and carrier Ethernet technologies are available as replacements for leased analog circuits.

The existing analog circuits leased by the Town of Carlisle will continue to be of concern as they will become more unreliable and potentially will be decommissioned in the indeterminate near future.

The general experience of public safety operators is that Verizon continues to provide less reliable service to its analog leased line customer base and the general public safety communications community in the region. Old copper, 4-wire analog circuits-based cable and hardware are not being fully supported and maintained and are problematic for numerous public safety operations locally. Verizon is not upgrading their analog infrastructure, and fewer personal are knowledgeable on the repair of these circuits due to continuing focus on digital infrastructure and fiber.

Leased Line Replacement Recommendation

Isotrope recommends that the town replace the leased lines with IP circuits. This can be done by extending municipal fiber to the remote radio receiver sites in town. (Our initial impression does not support efforts to deploy microwave backhaul to remote locations in town.) It may also

be useful to explore the availability of IP-based circuits from commercial providers such as Comcast and Verizon, especially for locations outside of town like Annursnac Hill.

Fiber

The cost for running fiber, including the fiber cable and line hardware, is roughly $18,500 per mile. This assumes there is municipal space available on the utility routes and no "make-ready" expense is necessary. Make-ready work is the work performed to create room on full or disorganized utility poles, relocate equipment that is in the way and even replace overloaded or failing utility poles. The cost to run fiber from the police station to the sites at Great Brook Farm (or North Street, instead) and 871 Bedford Street could be roughly $79,000. To run to a new voting receiver site at 1022 Westford Street would be an additional $40,000. Estimated budget for equipment is $10,000.

Since Annursnac is outside Carlisle's borders, and is not a short fiber route, it may be more challenging to run fiber to that site. However, with the many cell companies and other companies using the tower at Annursnac, there is likely to be readily available leased network capacity over fiber (such as from Comcast or Verizon) that could be utilized to replace the copper connection.

Microwave

Microwave links rely on line of sight between the locations. Due to the height of the tower and hill at Annursnac, it might be viable to make a microwave connection to a location in Carlisle. A clear line of sight above tree line would be necessary.[2]

Microwave links to other locations in town (such as the voting receiver locations) are generally unlikely because the height of the antennas at the remote locations is limited to below-tree levels unless towers are built at the remote locations.

If the leased copper link to the Annursnac Hill site could be replaced with a licensed microwave link, or if other microwave links were possible, a very coarse ballpark figure for engineering (structural, civil, and microwave network design) and equipment might be in the range of $25,000 to $35,000 per link (two microwave units and related electronics). The town would

[2] Near-line-of-sight ("NLOS") technology might support a grazing through-the-trees signal path, but in general, NLOS technology relies on multipath reception that is more consistent with urban signal paths.

need to negotiate microwave antenna locations with the respective owners of the towers at the remote locations.

Fire Department

If it is determined that the Fire Department communications should employ voting receivers at the Police Department locations, the Fire Department could share the benefits of a new digital backhaul network for the Police voting receivers. New digital links from each voting receiver site would have sufficient capacity to carry both the police and the Fire voting receiver signals.

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